Space Weather Technical Forecast

Issued on Sunday, 29 October 2023 at 13:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Storms expected 29 Oct with a chance G2/Moderate Storm intervals. Risk decreasing 30 Oct onward. Active fluence likely 31 Oct and 01 Nov.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Low with a recent series of C-class flares from AR3474, peaking at C4.3 at 29/0755 UTC. This is one of four sunspot regions on the disc, with the remaining three all weak, with limited evolution. AR3474 in contrast has demonstrated some notable development, with small but distinct penumbra forming in both polarities. AR3474 also retains a complex beta-gamma magnetic structure. No Earth-directed CMEs have been observed, with the main visible CME off the southeast disc assessed as being from the far-side.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 have increased gradually from ambient values to reach a peak of 600-650km/s by the end of the period as the Earth moves under the influence of the high speed stream from coronal hole 66. Density is around or below average. Total magnetic field strength was moderate, but fell to weak levels by the end of the period. The north-south component initially varied moderately, but is now only varying weakly. Phi angle has remained predominantly positive (away from the Sun). Geomagnetic activity was Unsettled to Active with two G1/Minor storm intervals at 29/0000-0300 UTC and 29/0600-0900UTC.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence remains well below the Active (1e8 integrated pfu) threshold. The observation at 29/0000UTC was 2.68e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low or Very Low solar activity is expected, mainly from AR3474. There is a very slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. The high speed stream from coronal hole 66 is currently connected to the Earth, giving solar wind speeds of 600-650 km/s. Speeds are expected to peak on 29 Oct, perhaps reaching 700 km/s before declining through the period. Unsettled to G1/Minor Storm activity is expected 29 Oct with a chance of an isolated G2/Moderate storm interval. Activity then easing through the period, with a chance of G1/Minor storms on 30 Oct, gradually reaching Quiet with isolated Unsettled intervals by 01 Nov.

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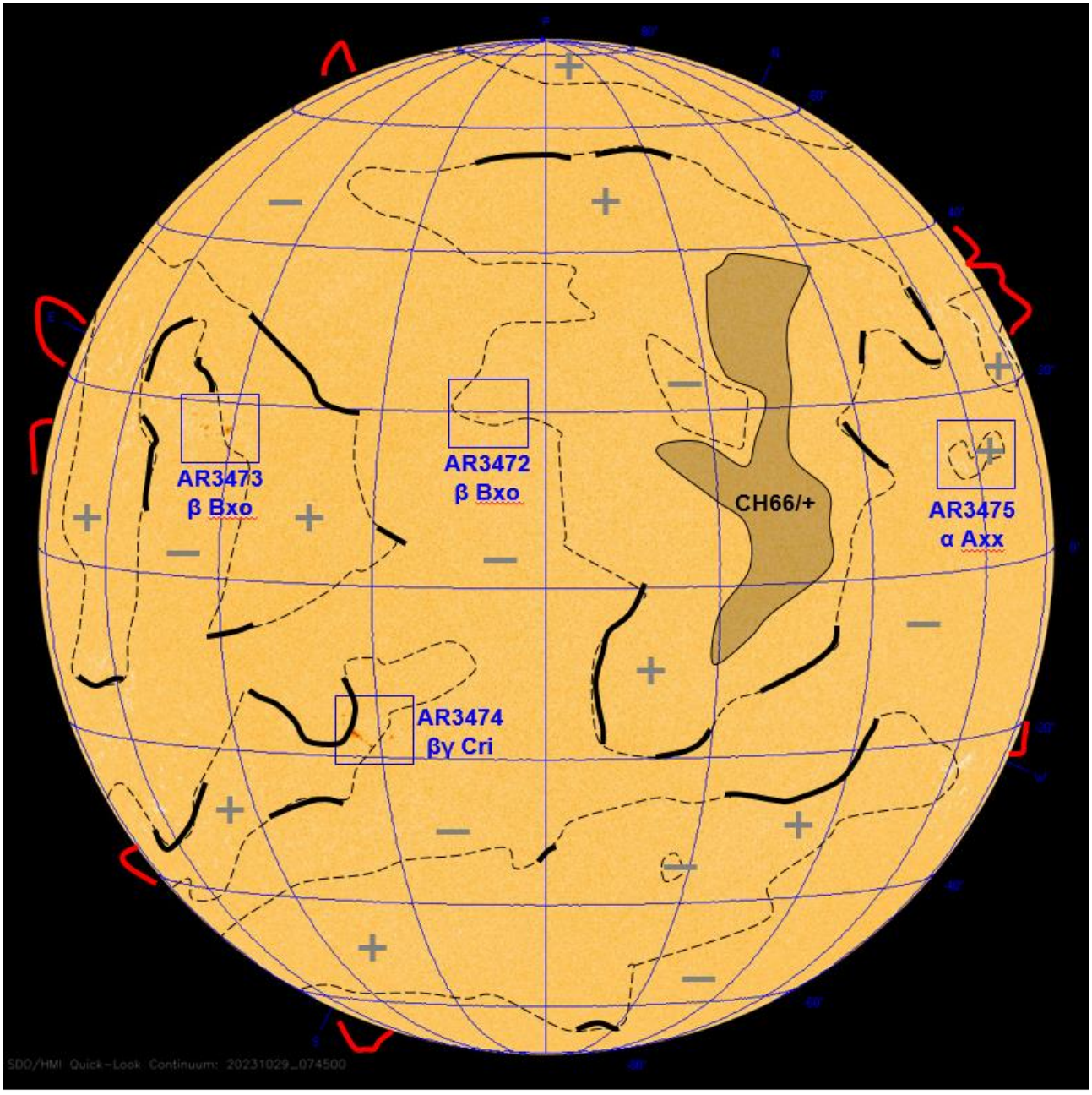
Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background. High energy electron flux (greater than 2MeV) is forecast to be at background at first, but increasing later in the period to Moderate, potentially High levels, as solar wind pressure from the current ongoing fast wind enhancement eases. This is most likely from late on 30 Oct. The associated 24 electron fluence is expected to see a rising trend, with a chance of reaching Active (1e8 integrated pfu) 31 Oct onwards.

Figure 1. Solar Analysis Valid 29/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
No Earth-directed CMEs are in the forecast.

Solar wind speeds have increased in the last 24 hours as the high speed stream from trans-equatorial coronal hole 66 in the western hemisphere appears to have connected with Earth. Speeds are peaking at around 600-700 km/s with a decline then possible from 30 October onward, but remaining elevated through to the end of the forecast period. As this coronal hole has developed markedly from the previous rotation, persistence is of no use, although the strength of the feature suggests that the effects will continue through the next few days.

There appears to have been a notable CIR ahead if the high speed stream, which resulted in the G1/Minor Storm effects at the onset of the coronal hole. Further G1/Minor Storms with a very slight chance of G2/Moderate storm possible on 29 October, with a chance of G1/Minor Storms through the 30 and 31 Oct as winds ease.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	80	40	20	1
Strong	**G3**	No	5	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2: Solar wind observations for the last 24 hours.

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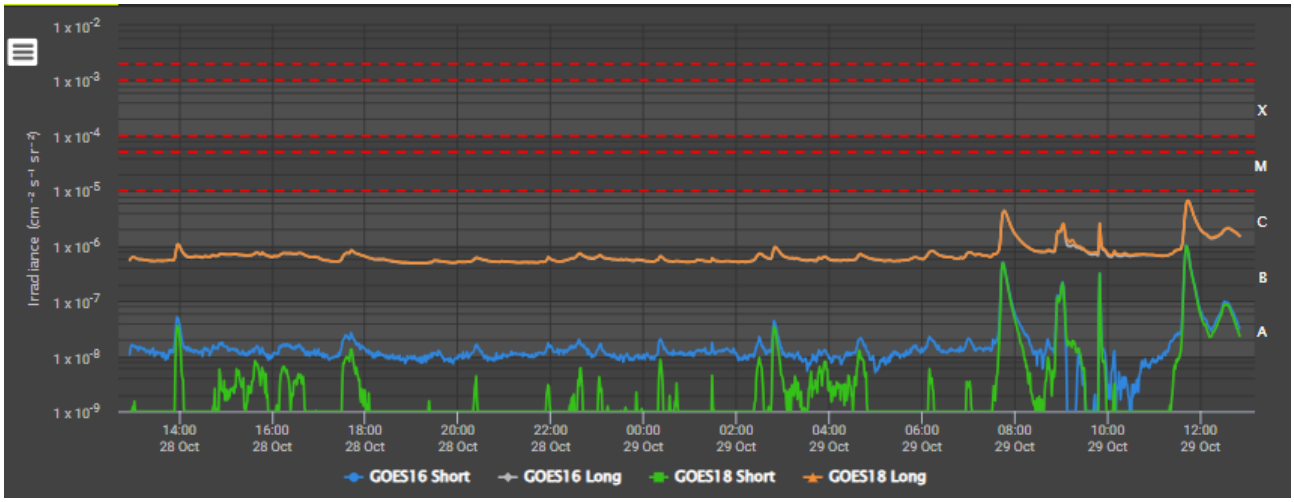
Radio Blackouts - X-Ray Flares:
Low or very low activity is forecast with only four sunspot regions on the visible disc. AR3474 is the largest, most complex and most active region in the disc. The penumbra in this region are becoming more distinct, with the recent development accompanied by a series of C-class flares. The remaining regions are all simple with very limited evolution.

A couple of potentially significant sunspots are on the far side of the disc, and may rotate onto the visible side from around 01 November

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	15	25
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES 16 X-ray flares



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant sunspot regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux is beginning to rise in response to the high speed stream from coronal hole 66 and the subsequent increase in electron populations in the radiation belts. There is an increasing chance of reaching the high threshold from late on 29 October and through the period as geomagnetic activity ease. However the solar wind pressure as a result of the strong speeds may distort the belts, with a sharp increase possible by 31 October and 01 November as the speeds begin to ease.

24-hour electron fluence is forecast to follow a rising trend through the next four days, with the Active threshold likely to be reached by 01 Nov. REFM is beginning to indicate a response to the solar wind enhancements and should soon start to reflect current conditions.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	30	50	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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